Picoeukaryote identification answer key

These questions can be posed as class discussion or debate, used with cooperative learning groups, as an individual assignment or a critique.

National Science Education Standards addressed:
- ✓ Life Science-Content Standard C

Benchmarks for Science Literacy addressed:
- ✓ The Living Environment-5_A, 5_C, 5_D
- ✓ Common Themes-11_D

Questions:

1. Imagine that you are an oceanographer and have sampled water from off the coast of Hawaii. You separate out the smallest eukaryotic phytoplankton (picoeukaryotes) and look at them under the microscope. You take the photos shown in Figure 1. How many different types of picoeukaryote were there in this sample? (Hint: Are you sure there is only one type of picoeukaryote per photo? Are you sure that every photo is a different picoeukaryote? Is it even possible to tell?) Explain.

It is not possible to determine exactly how many types of picoeukaryotes are present. They look so similar to one another – small, round, green/brown – that it is necessary to use other methods to look at diversity.

2. To determine how many types of picoeukaryotes are in the water, you decide to run a DGGE gel (Figure 2). You have sampled from 5 different depths at this station; the surface of the ocean, 50 m deep, 100 m, 150 m, and 200 m. Based on this gel, what is the total number of different types of picoeukaryotes found at this station? Explain.

5 – each band most likely represents a different type of picoeukaryote. They fall out at different spots on the gel because the sequence of the DNA is different in each of the 5 bands – indicating 5 different types of picoeukaryotes.

3. What can you conclude about the distribution of picoeukaryotes at this station as you move deeper into the ocean?

The number of different types of picoeukaryotes decreases as you move deeper in the ocean. At both the surface and 50m there are 4 different types of picoeukaryoes. At 100 and 150 m, there are 3 different types. By 200 m, there are only 2 different types of picoeukaryotes.

4. In order to learn more, you decide to sequence the bands so you can compare their DNA (Table 1). You are particularly interested in knowing if *Ostreococcus* sp is present at this station – it is the smallest know picoeukaryote and the focus of your research. So, you also acquire the DNA sequence for *Ostreococcus* sp for comparison (available from the National Center for Biotechnology Information - http://www.ncbi.nlm.nih.gov/). Is it possible that *Ostreococcus* sp is present at your site? Which bands you think are most closely related to *Ostreococcus* sp? Which are more distantly related? Explain.

Band C is exactly the same as the *Ostreococcus* sp. sequence, so it is possible that *Ostreococcus* sp. is present at the site. Band A is also very similar, with only 7 mismatches. Thus Band A is likely also closely related. The other 3 bands are more distantly related as they show less similarity to the *Ostreococcus* sp. sequence. (Note: Where there are * at the bottom, all sequences are the same. The easiest way to approach this is to investigate only the areas where there are no *. This dramatically reduces the number of bases you have to compare.)

5. What can you propose about the distribution of *Ostreococcus* sp at this station?

Assuming that band C is *Ostreococcus* sp. (or very closely related), we can observe that it is found everywhere that was sampled except at the surface. You could propose that *Ostreococcus* sp. prefers a deeper environment.

6. If you were to design a DNA probe able to locate all of these types of picoeukaryotes, which section of DNA would be most useful? Explain.

In order to locate all of these picoeukaryotes, you would want to use a fairly large section of DNA where all types have the same sequence. That way the DNA probe would attach to each of the 5 types of picoeukaryotes. For example, bases 4-16 are the same for all taxa. However, anywhere that has a * at the bottom, indicating that all bands have the same sequence, would be fine.

7. If you were to design a probe to identify just those related to *Ostreococcus* sp, which section of DNA would be most useful? Explain.

In order to just locate those related to *Ostreococcus* sp., you would need to find a section of DNA that was different between species. Bases 23-41 encompass a region where the *Ostreococcus* sp. sequence is very different from the other 4 sequences. Thus a probe using this sequence should only identify those closely related to *Ostreococcus* sp.